CLAIMS

1. A method for estimating a chemical mechanical planarization (CMP) result, comprising:

developing a neural network, wherein the neural network is configured to relate one or more CMP control parameters to a CMP result;

training the neural network using data for the one or more CMP control parameters and the CMP result; and

using the neural network to estimate the CMP result of a subsequent CMP operation based on the one or more CMP control parameters to be applied in the subsequent CMP operation.

2. A method for estimating a CMP result as recited in claim 1, wherein the CMP result is obtained using a linear CMP apparatus.

3. A method for estimating a CMP result as recited in claim 2, wherein the one or more CMP control parameters include an air bearing pressure and a platen height, wherein the CMP result is a wafer uniformity profile.

4. A method for estimating a CMP result as recited in claim 1, wherein the neural network is a static neural network having an input layer, one hidden layer, and an output layer.

5. A method for estimating a CMP result as recited in claim 4, wherein the one hidden layer includes a number of hidden neurons and the output layer includes one output

neuron, each of the number of hidden neurons having a hyperbolic tangent activation function, the output neuron being represented by a linear function.

6. A method for estimating a CMP result as recited in claim 1, further comprising:

selecting the data used for training the neural network from a design of experiments used to qualify a CMP apparatus used to produce the CMP result, wherein the data is selected to cover an anticipated range for the one or more CMP control parameters and the CMP result.

7. A method for estimating a CMP result as recited in claim 1, wherein the training of the neural network is based on an iterative minimization of an estimation error function performed using an adaptation of weights of the neural network, the adaptation of weights being based on a Levenberg-Marquardt algorithm.

8. A method for estimating a CMP result as recited in claim 1, further comprising:

updating weights of the neural network using the one or more CMP control parameters applied in the subsequent CMP operation and the CMP result of the subsequent CMP operation.

9. A method for adjusting control parameters of a chemical mechanical planarization (CMP) operation, comprising:

developing a neural network, wherein the neural network is configured to relate a comparison between a desired CMP result and an obtained CMP result to one or more CMP control parameters associated with the obtained CMP result;

training the neural network using data for the desired CMP result, the obtained CMP result, and the one or more CMP control parameters associated with the obtained CMP result; and

using the neural network to determine values for the one or more CMP control parameters to be used in a subsequent CMP operation such that the obtained CMP result for the subsequent CMP operation is acceptable relative to the desired CMP result.

10. A method for adjusting control parameters of a CMP operation as recited in claim 9, wherein the CMP operation is a linear CMP operation.

11. A method for adjusting control parameters of a CMP operation as recited in claim 10, wherein the one or more CMP control parameters associated with the obtained CMP result include an air bearing pressure and a platen height, the obtained CMP result and the desired CMP result corresponding to a wafer uniformity profile.

12. A method for adjusting control parameters of a CMP operation as recited in claim 9, wherein the neural network is a static neural network having an input layer, one hidden layer, and an output layer.

13. A method for adjusting control parameters of a CMP operation as recited in claim 12, wherein the input layer includes the desired CMP result, the one hidden layer

includes a number of hidden neurons, and the output layer includes an output for each of the one or more CMP control parameters.

14. A method for adjusting control parameters of a CMP operation as recited in claim 9, wherein the data used for training the neural network includes an estimation of the obtained CMP result generated using a second neural network to model the CMP operation.

15. A method for adjusting control parameters of a CMP operation as recited in claim 9, wherein the training of the neural network is performed using a recursive error back propagation method.

16. A method for controlling a chemical mechanical planarization (CMP) process, comprising:

(a) using a first neural network to determine settings for one or more CMP control parameters to be used in a subsequent CMP operation;

(b) using a second neural network to estimate a CMP result for the subsequent CMP operation, wherein the settings for the one or more CMP control parameters determined by the first neural network are used as input to the second neural network; and

(c) comparing the CMP result generated by the second neural network to a desired CMP result to provide feedback information to the first neural network.

17. A method for controlling a CMP process as recited in claim 16, wherein the CMP process is a linear CMP process, the one or more CMP control parameters include an

air bearing pressure and a platen height, and the CMP result corresponding to a wafer uniformity profile.

18. A method for controlling a CMP process as recited in claim 16, wherein each of the first neural network and the second neural network is a static neural network having an input layer, one hidden layer, and an output layer.

19. A method for controlling a CMP process as recited in claim 18, wherein the input layer of the first neural network includes the desired CMP result, the one hidden layer of the first neural network includes a number of hidden neurons, and the output layer of the first neural network includes an output for each of the one or more CMP control parameters.

20. A method for controlling a CMP process as recited in claim 18, wherein the one hidden layer of the second neural network includes a number of hidden neurons and the output layer of the second neural network includes one output neuron, each of the number of hidden neurons of the second neural network having a hyperbolic tangent activation function, the output neuron of the second neural network being represented by a linear function.

21. A method for controlling a CMP process as recited in claim 16, further comprising:

training the first neural network using data for the desired CMP result, an actual CMP result, and the one or more CMP control parameters associated with the actual CMP result.

22. A method for controlling a CMP process as recited in claim 21, wherein the actual CMP result is the CMP result generated by the second neural network in a previous CMP operation.

23. A method for controlling a CMP process as recited in claim 16, further comprising:

training the second neural network using data for the one or more CMP control parameters and an actual CMP result corresponding to the one or more CMP control parameters, wherein the data used for training is selected from a design of experiments used to qualify a CMP apparatus used to produce the actual CMP result.

24. A method for controlling a CMP process as recited in claim 16, further comprising:

repeating elements (a) through (c).

25. A computer readable media containing program instructions for controlling a chemical mechanical planarization (CMP) process, comprising:

(a) program instructions for using a first neural network to determine settings for one or more CMP control parameters to be used in a subsequent CMP operation;

(b) program instructions for using a second neural network to estimate a CMP result for the subsequent CMP operation, wherein the settings for the one or more CMP control parameters determined by the first neural network are used as input to the second neural network; and

(c) program instructions for comparing the CMP result generated by the second neural network to a desired CMP result to provide feedback information to the first neural network.

26. A computer readable media containing program instructions for controlling a CMP process as recited in claim 25, further comprising:

program instructions for repeating elements (a) through (c).

27. A chemical mechanical planarization (CMP) system, comprising:

a CMP apparatus for performing a CMP operation;

a data acquisition system for acquiring performance data associated with the CMP operation; and

a neural network system, the neural network system defined to implement a feedforward neural network and a neural network controller, the neural network system capable of using the performance data acquired by the data acquisition system to generate control data to be supplied to the CMP apparatus for performing a subsequent CMP operation.

28. A CMP system as recited in claim 27, wherein the neural network system is further defined to receive a reference input to be used in generating the control data to be supplied to the CMP apparatus.

29. A CMP system as recited in claim 28, wherein the performance data corresponds to an obtained CMP result and the reference input corresponds to a desired CMP result.

30. A CMP system as recited in claim 29, wherein the obtained CMP result and the desired CMP result corresponds to a desired material removal rate profile.

31. A CMP system as recited in claim 27, wherein the control data includes one of an air bearing pressure, a platen height, and both the air bearing pressure and the platen height.

32. A CMP system as recited in claim 27, wherein the subsequent CMP operation corresponds to a later phase of the CMP operation for which performance data is acquired.